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ABSTRACT

Strategies for apprehending and processing verbal material were studied in deaf and normal children by using color-word interference tasks. Color-word interference task was described as a method of apprehension evaluation with minimum memory contribution. The task involved three cards: one containing color patches, one containing printed names of colors, and one containing a color name printed in conflicting ink color. Seven deaf children and 17 normal-hearing children (age range 9-15 years) identified by good academic achievement were asked to name each card upon presentation. The task criterion was reading speed and thus, stimuli perception was the major variable studied. Data on time in seconds for subjects to complete the color-word interference task indicated that the deaf seemed able to view verbal material as objects without attending to its verbalness. Normal-hearing children, in contrast, had great difficulty in responding to anything other than the word itself. Results suggested that deaf children used qualitatively different strategies for apprehending and processing verbal material than did normal-hearing children. (CB)

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COLOR-WORD INTERFERENCE IN DEAF AND NORMAL CHILDREN[1]

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A number of studies suggest that subjects with severe hearing impairments employ strategies to retain and recall verbal material which are different from those used by normal-hearing subjects (Allen, 1969, 1970; Blanton & Nunnally, 1967; Blanton & Odom, 1968; Conrad & Rush, 1965; Odom & Blanton, 1967). In general, the normal-hearing subjects seem to use some aspects of the phonemic structure of words for memory while the deaf use some other attributes as yet not identified.

Allen (1970) suggested that this difference may be at the root of the problems encountered in developing language in the deaf, that these differences may, in particular, account for their retarded reading skills. Since reading is basic to the entire educational experience and habilitation process, the importance of such differences becomes apparent.

All of the tasks used so far to demonstrate differences have involved verbal material and memory. Conrad and Rush (1965) used letters of the alphabet in a short-term memory task; Odom and Blanton used memory for word phrases in one study (1967) and for trigrams differing in pronunciability ratings in another (Blanton & Odom, 1968) as did Blanton and Nunnally (1967); while Allen used rhyming words differing in spelling in a paired-associate paradigm (1969, 1970). Thus, differences in performance between deaf and normals may arise in the initial processing stage or in the retrieval stage. The present study attempted to identify the point at which the two groups diverge by assessing differences in initial processing.

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The color-word interference task, first described by Stroop (1935), presents a method for evaluating apprehension of materials with a minimum contribution of memory. Three cards are used in this procedure, one containing color patches, one containing the printed names of the colors, and a third on which the color names are printed in conflicting colors of ink (e.g., the word "red" is printed in yellow ink). The subject names the patches or words on the first two cards and the time taken to complete each is recorded. These values provide an index of reading speed for colors alone and words alone. The third card is the test of interference; the subject is required to name the color of the ink, not the word. This task requires much more time to complete; the simplest explanation is that the word-reading habit is stronger than the color-naming habit thus producing interference (Jensen & Rohwer, 1966), although not all agree (e.g., Treisman & Fearnley, 1969). One might say that whenever words are present, the typical subject has difficulty not reading them and attending to other dimensions, i.e., he has a "compulsion to read."

Since reading speed is the criterion in this task, perception of the stimuli is the major variable being studied and aids in determining where the differences between normal-hearing and hearing-impaired performances arise. If reading levels of the hearing and deaf subjects are controlled, then the habit to read should be equally as strong in both groups and no difference should be obtained on the color-word task. However, if the differences already documented between deaf and normal subjects reflect qualitatively different approaches to verbal tasks, as Allen (1969, 1970) has suggested, then a difference in performance on this task would be expected as well, with deaf performing better than normals.

Method

The specific materials used in this study consisted of three cards, 7" x 5½", each with five rows and four columns of 1" x 1" squares outlined in black, and a stopwatch. Card C, the color card, has a solid color in each square. Four colors were used, red, yellow, blue, and green. Each row had all four colors but the sequence was different in each row. Card W, the word card, had one of the color names printed in black within each square. Again all color names appeared in each row but the sequence differed. Card CW, the color-word card, also had a color name printed in each square but a conflicting color of ink was used to print the name. Each row contained all four colors but the order differed in each row.

Subjects for this study were seven deaf children and seventeen normal-hearing children. Deaf subjects were enrolled in a residential school for the deaf. They were required to have grade-equivalent reading levels of between 3.5 and 6.0. This is an oral school and all were considered to be good students. All had hearing losses averaging greater than 80 dB; their ages ranged from 10-15 years with a mean of 12.9. Normal-hearing subjects were in grades 3-6 and performing at grade level; their ages ranged from 9-12 years with a mean of 10.4. Both sexes were represented in each group.

The experimenter, who was experienced in working with deaf children, sat beside the child and showed him card C. The subject was instructed to "say the colors you see as fast as you can." The experimenter demonstrated by pointing to the colors in the top row from left to right while naming them aloud. The card was then rotated 180° and the subject told to begin. Timing was begun as the subject named the first color and ended when he named the last color. Card W was presented next and the subject was told to read the

color names as fast as he could; the time taken was recorded as before. Card CW was presented last with instructions to name the color seen and not to read the word. The experimenter demonstrated by pointing to the square in the lower left corner, saying "you should say yellow, not red." The subject was then directed to the upper left corner of the card and told to begin. Timing was as for the other cards. All cards were held about 18 inches from the subject.

Results

Table 1 summarizes the performance of the two groups of children on the

Insert Table 1 about here

three cards of the task. As shown there, the groups did not differ in the amount of time taken to read the color card but the deaf were both significantly slower in reading card W and faster in completing the CW card. Thus, although the deaf were slower at reading the color names, they exhibited less interference on the CW card than did the normals.

While these results satisfied the original purpose of the study, additional aspects of the data were examined in order to gain further insight into the differences in performance between the two groups A number of different scoring formulas for the Stroop test have been used by different authors to index different psychological variables (Jensen & Rohwer, 1966). Those that seem most relevant to the groups used here are C/W, (CW-C), and (C-W)/W, termed indices of verbalness, interference proneness, and verbal specialization, respectively. These data are summarized in Table 1, also, and show that normals scored significantly higher than the deaf on all three measures.

The correlations between the times taken to complete each of the cards were also examined. Table 2 presents the intercorrelations among the three

Insert Table 2 about here

measures for the two groups along with typical values for these same measures

reported by others. The correlations obtained for the normal-hearing children in this study are compatible with these other values in that the W vs. CW relationship is the weakest. More interest is the discrepant pattern shown by the deaf in this respect. Even with the small sample size, two of the correlations are significantly different from zero, one of these being the relationship between W and CW. The deaf do not show any marked difference from other groups in the magnitudes of the other two correlations.

Discussion

The finding that the deaf exhibit less interference on the conflicting CW card than did the normals lends further support to the assumption that the differences observed between normal-hearing and hearing-impaired groups in a number of studies is related to differences in how they initially process the material or stimulus situation. The deaf do not show a "compulsion to read" to the same degree as do normals when confronted with verbal material. The fact that the deaf were slower on Card W was surprising and may indicate that reading levels are not an adequate basis for comparing groups. However, this slower performance may be yet another indication of fundamental differences between normals and deaf. The score for W has been termed the only clear-cut measure of a speed factor (Jersen & Rohwer, 1966); the difference obtained may mean that the deaf are slower in "personal tempo" and may bear no relationship to reading ability. Further research is needed to clarify this finding.

Certainly the difference between groups in reading speed for words alone does not weaken the significance of the CW score difference. The correlations reported between W and CW are positive for all groups indicating that faster readers for words alone show less interference. The fact that the deaf show an exceptionally strong relationship between W and CW adds further weight to the assumption that the deaf are not just "normal" people who cannot hear.

The derived scores emphasize the difference between normal and deaf performance. As expected, the normals scored higher on verbalness and verbal specialization while the deaf were less prone to interference using these indices.

The results of this study, then, suggest even more strongly that the hearing-impaired use qualitatively different strategies for apprehending and processing verbal material than do normal-hearing subjects. The deaf seem able to view verbal material without attending to its "verbalness," i.e., they can view words as they do objects, and thus can easily attend to other characteristics of the stimuli. In contrast normal-hearing subjects have great difficulty in responding to anything other than the word itself. The techniques used for education and habilitation of the hearing-impaired should be evaluated in terms of this difference; perhaps, with more suitable methods, the linguistic problems of the deaf can be more easily resolved.

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Table 1

Time in seconds for normal (N=17) and deaf (N=7) subjects to complete the color-word interference task

	Normal		Deaf		
Scores	$\bar{X}$	s	$\bar{X}$	s	t
Basic					
C	12.45	3.28	12.27	2.75	.13
W	8.65	1.70	10.94	2.60	2.57*
CW	28.24	6.63	22.21	2.30	3.30**
Derived					
C/W	1.44	.24	1.14	.17	3.00**
CW-C	15.79	5.62	9.94	2.54	2.62*
(C-W)/W	.45	.26	.14	.17	3.10**

*p < .05; **p < .01

Table 2

Intercorrelations among basic scores for adults and children

	Adults			Children			
Scores	Jensen[a]	Broverman[a]		Normal[b]	Retardate[b]	Normal[c]	Deaf[c]
W vs. C	.52	.74	.80	.57	.48	.73**	.72*
W vs. CW	.43	.57	.63	.50	-.04	.36	.72*
C vs. CW	.66	.76	.81	.58	.27	.53*	.50

[a]Jensen & Rohwer, 1966.

[b]Das, 1969.

[c]This study.

[d]$p < .05$; **$p < .01$

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